Ontario

Foods of Plant Origin

Cleaning & Sanitation Guidebook

Ministry of Agriculture, Food and Rural Affairs

The primary objective of every food safety program is to prevent, minimize or control microbial, chemical and physical contamination.

For information or to obtain copies of this publication, contact the Ontario Ministry of Agriculture, Food and Rural Affairs at 1-888-466-2372 ext. 64395 or (519) 826-4395 or food@omafra.gov.on.ca.

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About This Guidebook

Adequate cleaning and sanitation in a food processing facility are essential to produce safe food. Inadequate cleaning and sanitation can lead to food contamination and can decrease product quality and shelf life.

This guidebook helps food processors and packers select cleaners and sanitizers suitable for their foods of plant origin operations. It outlines the steps required to use these cleaners and sanitizers effectively.

Of course, adequate cleaning and sanitation will not single-handedly guarantee safe food. Many other factors, including good housekeeping practices, the personal hygiene practices of food handlers, the level of training of those handling food, the design and maintenance of the plant and processing equipment, water quality and pest control, also affect sanitation and resulting food safety.

These, and other operational and environmental practices, are discussed in detail in the following food safety publications published by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA):

- *Minimally Processed Fruit and Vegetables Good Manufacturing Practices Guidebook*
- *Sprouted Seeds Good Manufacturing Practices Guidebook*
- *Food Safety Practices for the Production of Maple Syrup*
- *Food Safety Practices for the Production of Unpasteurized Apple Cider.*

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Why Clean and Sanitize?

Food processing environments that are not adequately cleaned and sanitized can be a source of microorganisms that cause food spoilage and foodborne illness. These microorganisms may be bacteria, moulds, yeast, viruses or parasites.

When nutrients and moisture are available and when the environment is favourable (suitable pH, temperature and oxygen level), bacteria, moulds and yeast multiply in food. Viruses and parasites survive in food but depend upon a living host (including the human body) to grow and reproduce.

Food spoilage microorganisms reduce shelf life by causing changes in food colour, texture, flavour and/or smell. These changes make the food undesirable or unsuitable for human consumption. Pathogenic microorganisms, which may produce illnesses or illness-causing toxins, do not create any visible changes in food.

Unclean food processing surfaces provide an ideal environment for the growth of microorganisms. When food comes in contact with unclean surfaces, food-spoilage or pathogenic microorganisms can be transferred to the food being processed. This transfer of microorganisms from a contaminated source to a non-contaminated source is called cross-contamination.

Proper cleaning and sanitation of equipment, work surfaces and utensils will:

- Remove dirt and/or food material that harbour microorganisms
- Eliminate most bacteria, including pathogens
- Prevent cross-contamination
- Extend shelf life
- Improve food safety
- Increase protection against financial losses.

What's the Difference?

While the terms are often used interchangeably, **cleaning and sanitation have two entirely different purposes.**

Cleaning is the removal of unwanted material (commonly called soils) from production equipment and production areas. Removing leftover particles eliminates many microbes, their food source and other physical debris that can contaminate future batches of food. Appropriate cleaning chemicals may be applied manually or mechanically to equipment that remains assembled (clean-in-place) or that is partially or fully disassembled (clean-out-of-place). Most often, a combination of methods is used.

Sanitizing is the treatment of a clean surface with a chemical or physical agent (e.g., heat) to reduce microorganisms that cause disease and/or spoilage to levels considered safe for public health. By definition, sanitizing a food contact surface must reduce the population of specific bacteria by 99.999 per cent (a 5 log kill)[1] in 30 seconds. Non–food contact surfaces require a reduction of 99.9 per cent (a 3 log kill), also within 30 seconds. When microbial populations are

reduced to these levels, the surfaces are considered to be microbiologically clean.

It should be noted that sanitizers do not destroy all pathogens. For example, if there are 1 million bacteria per square centimetre, a 99.999 per cent (5 log) kill still leaves 10 bacteria per square centimetre. Some of these may be pathogens or spoilage-causing organisms. Under optimal growing conditions (e.g., food, water, nutrients, and suitable pH, temperature and oxygen level), the population of the surviving bacteria may double every 20 minutes. Therefore, surfaces that are microbiologically clean immediately after cleaning and sanitizing operations may develop high bacterial levels if left undisturbed for a period of time (e.g., overnight). As a general rule, surfaces left for more than four hours must be sanitized again before production resumes.

Undesirable microorganisms (pathogens and/or spoilage-causing organisms) may come from:

- Ingredients (e.g., fruits and vegetables to be processed or packed)
- People (e.g., dirty hands)
- The building (e.g., dirt and condensation dripping from overhead pipes, dirty drains or unclean doorknobs)
- Equipment (e.g., packaging equipment, pallet truck travelling through the building, dirty buttons and switches, or dirty cleaning brushes)
- Improperly stored garbage and product residues
- Non-potable water
- Pools of water on the floor
- Rodents and other pests
- The air (via aerosols)
- Many other sources.

Biofilm

Incomplete cleaning/sanitation encourages the development of a biofilm, which becomes an ongoing source of bacterial contamination from apparently clean surfaces. Both pathogenic and spoilage microbes can form a biofilm.

A biofilm is a microcolony of bacteria that securely attaches itself to an inert surface using complex polysaccharide-like material. Once formed, a biofilm provides bacteria with an environment that is favourable to their survival while protecting them from flows of liquids, changes in pH or temperature, and chemical cleaners and sanitizers.

Biofilm can form on the surface of hoppers, conveyors, mixers, grinders, fillers or any other surface that is in continuous contact with food. The microcavities of porous surfaces such as elbows, junctions, cracks, and splits are also ideal areas for the accumulation of residues and biofilm-forming bacteria.

Once in place, a biofilm is extremely difficult to remove or sanitize. Removal often requires sophisticated cleaners with oxidizing agents. The best defence against biofilm development is prompt, regular, complete cleaning and sanitation of all food production surfaces.

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[1] The term "log" is an abbreviation of "logarithm." A logarithm is a "power of ten" (10[1]). Each logarithmic reduction reduces the microbial population by 90 per cent.

Cleaner Selection

The choice of cleaning chemicals is determined by:

- The type and/or combination of types of unwanted matter (soils)
- The composition and area of the surface to be cleaned
- The method of cleaner application
- Characteristics of the water used.

Soils

Residual soils in food processing facilities may generally be classified as organic or inorganic. Generally, only organic soils will be encountered in foods of plant origin processing facilities.

Alkaline cleaners are used to remove organic soils. For specific applications, alkaline cleaners are commonly blended with other chemical agents to dissolve, suspend and disperse soils. Typically, these cleaning agents consist of an alkaline cleaner, surfactants and chelating agents.

Food Soil Characteristics

Soil Type	Solubility	Ease of Removal
Starch	Water, Alkali	Easy to Moderately Easy
Sugar	Water	Easy
Fats/Oils	Alkali	Difficult
Protein	Alkali	Very Difficult

Moderately alkaline cleaners include disodium carbonate, sodium metasilicate and tri-sodium phosphate (TSP). Carbonate-based detergents have limited use in food processing plants because they interact with calcium and magnesium to form highly insoluble compounds. Silicates are most often included in cleaners to inhibit corrosion. TSP has a long history of effectiveness against organic soils. Water conditioners, corrosion inhibitors, and wetting or emulsifying agents may also be formulated into cleaners.

Highly alkaline detergents (e.g., caustic soda/sodium hydroxide, caustic potash/potassium hydroxide) are used in many circulating clean-in-place (CIP) systems.

Fresh soils are more easily dissolved than old, dried-on deposits. Using too hot water or improper cleaners can "set" soils, making them more difficult to remove. Working promptly with the proper cleaner will ease soil removal.

Inorganic soils are soluble in acid chemicals. Cleaners such as nitric, phosphoric and muriatic acids are used to remove hard-water scale, mineral deposits, rust and films left by incomplete rinsing of alkaline cleaners.

Surfaces

Surface composition influences the effectiveness of different cleaning and sanitizing chemicals. Although 300 series stainless steel or food-grade plastic is the recommended surface for food production, other surfaces are sometimes used.

300 series stainless steel is corrosion resistant, durable and easy to clean. However, prolonged use of strong acidic cleaners in combination with chlorine may damage stainless steel. 400 series stainless steel is more prone to corrosion than is 300 series.

Surfaces and Cleaner Summary

Stainless steel	Use non-abrasive acidic and alkaline cleaners; do not use hydrochloric acid or chlorides; corrosive properties vary with grade
Plastic	More corrosion resistant than stainless steel; resistant to chlorine; may crack or cloud from prolonged exposure to strong acidic or alkaline cleaners; easily scratched
Nylon	Do not use acidic cleaners
Rubber	Deteriorates with constant use of chlorine; use alkaline cleaners
Brass, copper, mild steel	All less corrosion resistant than stainless steel; acidic cleaners encourage steel rusting; use moderately alkaline cleaners with corrosion inhibitors
Aluminum	Readily attacked by acidic and highly alkaline cleaners, use only soft metal-safe moderately alkaline cleaners
Wood	Should not be used in food applications; where used, clean with detergents containing surfactants
Iron drains	Acidic cleaners are corrosive; use moderately alkaline cleaners
Painted surfaces	Use moderately alkaline cleaners
Concrete	Use alkaline cleaners

Food-grade plastics are smooth and impervious. However, effective cleaning may become difficult if the surface becomes scratched, pitted or scored. When a pitted, cracked, corroded or rough surface reaches the point that it can no longer be effectively cleaned or sanitized, it should be replaced.

Wood is easily damaged, creating cracks and crevices that harbour microorganisms. Wood should be cleaned with an abrasive cleaner and sanitized well. The use of wood is **not** recommended for food contact surfaces or in areas of prolonged water exposure.

Iron-based alloys (e.g., carbon steel) are prone to rusting. Acidic cleaning compounds encourage rust formation, as do chlorine sanitizers. Only neutral cleaners should be used on iron-based or galvanized surfaces. Tin surfaces are sometimes an alloy of tin and lead, so their use is not recommended because exposure to lead is known to have adverse effects on human health.

Painted surfaces have different characteristics depending upon the paint used. **OMAFRA does not recommend painting food contact surfaces.** Regardless of the surface painted, only paint acceptable to the Canadian Food Inspection Agency (CFIA) should be used.

Acids and acid cleaners corrode concrete floors, so only alkaline cleaners should be used. Pitted or cracked concrete floors should be sealed with coating acceptable to the CFIA.

A list of acceptable paints and acceptable floor coatings may be accessed at www.inspection.gc.ca/english/ppc/reference/cone.shtml or by calling your local CFIA office.

Application

Chemical cleaners may be applied manually, in a soak solution, as a low-pressure wash or using an automated CIP system. Each application method has advantages and disadvantages. Most food processing facilities use a combination of these procedures.

Manual Cleaning

Advantages:

- Low-cost equipment required; affordable in small operations
- Adaptable to all types and sizes of facilities, equipment and tools
- Milder, generally safer, chemicals used
- Immediate observation of cleaning efficacy

Disadvantages:

- Effectiveness often depends on worker industriousness
- Cleaning can be inconsistent
- Labour intensive
- Mild chemicals required for safe human handling may be ineffective
- Greater opportunity for cross-contamination by workers and tools

Clean-out-of-Place (COP) System

Advantages:

- Minimal labour required
- Longer period of time for cleaner to act

Disadvantages:

- Requires disassembly
- Soak tank often requires agitation to be effective
- Incorrect cleaner can damage equipment because of extended contact time

Low-Pressure Wash

Advantages:

- Can be used for both rinsing and application of foam cleaners
- Fast application of cleaners on walls, floors and stationary equipment
- Easier to reach "hard-to-clean" areas

Disadvantages:

- Too high pressure may cause cross-contamination by aerosols and oversprays
- Low-pressure systems generally require higher volumes of water
- Loss of water temperature during application

Clean-in-Place (CIP) System

Advantages:

- Reduced labour required with automation
- More consistent, effective cleaning
- More powerful cleaners can be used
- Optimal use of water and cleaner
- Cleans difficult to access areas (e.g., inside pipes)

Disadvantages:

- Higher capital cost; higher maintenance costs
- Not all equipment can be cleaned in place
- Easy to ignore automated systems; routine monitoring is necessary to ensure that the system is working effectively

Water

Water makes up 95 to 99 per cent of cleaning and sanitizing solutions. It carries cleaner and sanitizer to the surface and carries contamination away from the surface. Water impurities can drastically alter the effectiveness of a detergent or sanitizer.

Water used for food processing, cleaning and sanitizing activities must be potable (must meet Ontario Drinking Water Quality Standards, O. Reg. 169/03, under the Safe Drinking Water Act, 2002). Potential water (and ice) contaminants may be microbiological, chemical or physical.

While all may cause adverse health effects, microbial contamination is generally of greatest concern.

Water: Mineral Content

Minerals (calcium and magnesium salts) found in water can negatively affect the performance of cleaners and sanitizers. These salts not only tie up active ingredients, requiring higher application rates, but also may precipitate out as mineral scale. This scale is an ideal place for microorganisms to attach as a biofilm in which they are protected from cleaners and sanitizers. In addition, scale buildup can reduce heat-transfer efficiency and reduce the internal diameter of pipes.

Summary of Water Hardness

Water Hardness Rating	Calcium Carbonate Content (ppm)	Grains per Gallon
Soft	0–60	0–3.5
Moderately hard	60–120	3.5–7
Hard	120–180	7–10.5
Very hard	over 180	over 10.5

Where hard water must be used for cleaning, the addition of chelating or sequestrating agents (a water softener) is necessary. Surfactants are sometimes mixed with water to reduce surface tension (making water wetter) and to help overcome water hardness.

Water: Microbial Content

Water may contain enteric pathogens (bacteria, viruses and parasites), which can be transmitted to humans. While bacteria do not multiply in water, many can multiply in food. Viruses and parasites do not reproduce in food.

Waterborne Pathogens

Bacteria	Salmonella, Shigella, pathogenic strains of E. coli (e.g., O157:H7), Vibrio, Heliobacter, Yersinia, Campylobacter
Viruses	Noroviruses, Enteroviruses, Hepatitis A, Rotavirus
Parasites	Giardia, Crytosporidium, Cyclospora, Amoeba, Toxoplasma, Roundworms, Flatworms, Tapeworms

Water: Chemicals

Chemicals, such as pesticides, synthetic organics, nitrates, arsenic, lead, mercury and asbestos are sometimes found in water. In large enough quantities all are potentially toxic. Chemical contamination can result from chemical spills, incorrect use of pesticides, improper water treatment, or cross-contamination with sewage or industrial waste.

Water: Physical Characteristics

Physical characteristics of water, including colour, odour, taste, temperature and turbidity (cloudiness) are primarily aesthetic and generally pose very small health risks, but may affect food quality.

CFIA recommends that municipal water used in food processing should be tested twice a year by the processor. Water from other sources should be tested once each month. Many food processors have found it advantageous to install water treatment devices (e.g. chlorinator, UV light, ozonation device, etc.) in order to ensure water is potable.

Because use of contaminated water can cause severe consequences, many food processors test much more frequently; some as often as every day. Private laboratories perform coliform and E. coli water analysis for a fee in the $25 to $30 range. In addition to

bacteria, food processors may also wish to test water for metals, minerals and pesticides.

Sanitizer Selection

Sanitation may be achieved using either heat (thermal treatment) or chemicals.

Heat

Hot water sanitizing is commonly used where immersing the contact surfaces is practical (e.g., small parts, utensils). Both time and temperature are important.

Depending upon the application, sanitation may be achieved by immersing parts or utensils in 77°C to 85°C water for 45 seconds to 5 minutes.

A 45-second immersion in 77°C water is equivalent to immersion in:

- A 100 ppm chlorine solution for 45 seconds
- A 200 ppm quaternary ammonium solution for 45 seconds
- A 25 ppm iodine solution for 45 seconds.

Larger equipment may be sprayed with the same temperature water for the same period of time. However, it is important to remember that, when cooler equipment is immersed in hot water, or hot water is sprayed on cooler equipment, the water temperature will decrease rapidly, so killing power is lost. Hot water sanitizing is effective only when appropriate temperatures can be maintained for the appropriate period of time.

Hot water sanitation is easy to apply, readily available, effective for a broad range of microorganisms, non-corrosive, and penetrates cracks and crevices. However, it is relatively slow, can contribute to high energy costs, may contribute to the formation of biofilms, may shorten the life of certain equipment of parts (e.g., seals and gaskets) and can be a safety hazard to employees. Fungal spores will survive this treatment. Because hot water spraying is very energy inefficient and can raise the temperature of the surrounding area, this practice is generally not recommended.

Chemicals

There is no perfect chemical sanitizer. Effectiveness depends on:

- Sanitizer concentration (too low or too high is ineffective)
- Surface contact exposure time
- Temperature of the sanitizing solution (generally, 21°C to 38°C is considered optimal)
- pH of the water solution (each sanitizer has an optimal pH)
- Cleanliness of the surface to be sanitized (an unclean surface cannot be effectively sanitized
- Water hardness.

All sanitizers used in food production facilities in Ontario should be acceptable to the CFIA. The CFIA sanitizer list may be found at the CFIA's Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products. It may be found at www.inspection.gc.ca/english/ppc/reference/cone.shtml

Selection of a cleaner and sanitizer supplier is extremely important. As well as supplying chemicals, the supplier should also be able to provide informed expertise regarding chemical selection and use.

Chlorine

Chlorine is the most commonly used sanitizer in food production facilities. The effectiveness of chlorine depends on several factors:

- The amount of turbidity and chemicals (e.g., iron, manganese, hydrogen sulfide and ammonia) in the water that "use up" chlorine
- The concentration of the chlorine solution added
- The time that chlorine is in contact with the surface
- Water temperature
- Water pH.

When chlorine is added to water, some of it combines with dissolved chemicals and organic material in the water and is "used up." Only the remaining "free" chlorine (hypochlorous acid) is available to destroy microorganisms present. Free chlorine levels can be easily measured using a commercially available test kit or a chlorine meter. Be sure to measure free chlorine levels, not the total chlorine. Frequent testing will ensure that chlorine concentration is maintained at the level required for sanitation. All measurements should be recorded in a log book.

Non-porous (e.g., metal, hard plastic) food contact surfaces should be sanitized with a 100–200 ppm "free" chlorine solution for a minimum of 45 seconds. A chlorine solution of 600 ppm is recommended for porous surfaces (e.g., wood, soft plastic) but, at this concentration, food contact surfaces must be rinsed afterward. Higher concentrations (e.g., 1,000–2,000 ppm) may be used on walls and floors.

It is wise to wear protective clothing and eye covering when using chlorine solutions. Also, make sure that the area is well ventilated.

Contact time of two minutes is considered sufficient to reduce pathogen populations to an acceptable level when the surface is free of organic matter. After sanitizing, allow the surface to air dry.

The following formula may be used to calculate the correct amount of chlorine to add to potable water to achieve a desired concentration.

$$\frac{\text{(desired ppm of chlorine)} \times \text{(total water volume)}}{\text{(\% hypochlorite in sanitizer)} \times (10{,}000)} = \text{litres concentrated chlorine to add}$$

Sample calculation:

- 250 litres of 200 ppm chlorine solution required
- Unscented household bleach available as chlorine source (5.25% chlorine)

$$\frac{200 \text{ ppm chlorine}}{5.25\%} \times \frac{250 \text{ litres}}{10{,}000} = 0.95 \text{ litres required}$$

The same formula may be used for granular bleach formulations (e.g., 65% calcium hypochlorite).

Temperature also affects chlorine effectiveness. Temperatures should be 24°C (72°F) or a little higher (e.g., lukewarm/tepid water). Chlorine is ineffective above temperatures of 46°C. **A word of caution: dangerous chlorine gas is released if chlorine is used in hot water.**

Water pH level influences the chlorine concentration required for effective sanitation. The optimum pH is 6.5 to 7.0, but chlorine remains effective within a pH of 6.0 to 7.5. **If the pH falls below 4.0, dangerous chlorine gas (mustard gas) is produced.** Solution pH should be checked after chlorine is added. (pH may be adjusted with commercially available buffers).

Chlorine is relatively unstable so chlorine solutions gradually lose strength even in covered containers. Fresh solutions must be prepared frequently. Maximum storage life is 24 hours. Always label containers containing chemical solutions.

Chlorine is incompatible with most other chemicals. Do not mix chlorine with detergent cleaners. When mixing chlorine solutions, **always add concentrated chlorine to water;** never add water to chlorine to avoid possible explosions when mixing chlorine solutions.

Iodine/Iodophors

Iodophors (a mixture of iodine and surfactant) have broad-spectrum activity and are effective against a wide range of bacteria, viruses, yeasts, moulds, fungi and protozoans. Although less affected by organic matter and water hardness than chlorine, iodophors have a limited effective temperature range (24°C–34°C). They are least effective at low temperatures and vaporize at 49°C. They are most effective at low pH (2.5–3.5) levels. Iodophors have 2.5 times the oxidizing power of chlorine, so a lower concentration is required (e.g., 25 ppm). Iodophors can stain and discolour equipment, especially plastics. They are widely used in the meat industry.

Quaternary Ammonium Compounds (Quats)

A diverse class of compounds, "quats" are the only sanitizer group with true residual activity. For this reason, they are often used on floors, walls, drains, and equipment that will remain idle for longer than 24 hours. Because quats contain surfactants, they can be "foamed" onto vertical surfaces. A concentration of 200 ppm at 24°C to 44°C with a contact time of 45 seconds is required for sanitation. Because quats adhere to surfaces, food contact surfaces must be rinsed before use.

Quats are non-corrosive, odourless and non-staining. They are effective on porous surfaces and effective over a wide pH range. Their effectiveness diminishes in hard water. Organic matter moderately affects their efficiency. Quats are effective at killing yeast, mould, E. coli and Salmonella. They are not compatible with common detergent compounds or chlorine sanitizers.

Compared to chlorine, quats are relatively expensive.

Phenols

Do not use phenols in food processing plants. Phenol odours can penetrate food, causing objectionable flavours and odours in the food. Their use should be limited to washrooms.

Peroxyacetic Acid (PAA)

Peroxyacetic acid is effective against a broad spectrum of coliforms, bacteria, yeast and moulds. It is effective at temperatures from 5°C to 40°C and at a pH up to 8.0. It decomposes to acetic acid (vinegar), water, oxygen and carbon dioxide.

PAA is most commonly used in fresh-cut, further processed, and post-harvest fruit and vegetable flume and wash water systems, especially in applications where high organic matter would significantly decrease the effectiveness of chlorine. Different formulations are designed to be used directly on whole and processed fruit and vegetable surfaces, on food and non–food contact surfaces, and in clean-in-place (CIP) systems. Rinsing is generally not required.

Peroxyacetic acid can be very expensive.

Selecting a Supplier

Selection of a cleaner and sanitizer supplier is extremely important. As well as supplying chemicals, the supplier should also be able to provide informed expertise regarding chemical selection and use. Periodically, it is wise to review the cleaning and sanitation program to determine if it is effective. This review may include post-sanitation tests for microbes (environmental swabs) on selected surfaces in the facility.

Cleaning and Sanitation Methodology

Because sanitizing requires direct contact between the sanitizer and the microorganisms to be killed, surfaces must be clean before a sanitizing solution is used. The presence of organic matter significantly reduces the killing power of sanitizing solutions.

The following steps are required for cleaning and sanitizing:

1. Remove/cover food, ingredients and packaging materials from the area to be cleaned. Cover electrical equipment and other equipment that could be damaged by water.

2. Using brooms, shovels, squeegees, etc., physically remove as much soil and other debris as possible from equipment, utensils, preparation areas and floors. Place in clearly marked "inedible" containers for prompt disposal. In addition to reducing water usage, "dry" cleaning will reduce the risk of cross-contamination caused by water overspray and lessen opportunities for high-risk drain pooling and backups.

Disassemble equipment, as required. Do not place disassembled food contact surface equipment on the floor. Even if it is cleaned and sanitized before reassembly, its floor "storage" location may prevent complete sanitation. Clean, dedicated carts or racks should be provided to clean and sanitize or to transport disassembled

pieces to appropriate soak or circulation tanks for cleaning and sanitizing.

3. Using 43°C to 50°C potable water, rinse walls from the top down, equipment from the top down and in the direction of product flow, and floors. Don't forget the underside of counters, tables, belts, etc. and other cracks and crevices where soil may be hidden. Use the lowest effective water pressure (increase volume to compensate for decreased pressure) to reduce the risk of cross-contamination caused by aerosols and oversprays. Excessive pressure may also cause machine damage. Where conditions require higher pressures to remove surface soils, high-pressure sprays must be limited to this step during cleaning procedures.

Following this step, walls, equipment and floors should look clean.

4. Apply cleaning agents to loosen any remaining "invisible" soil and keep it in suspension. Apply to walls, floors and equipment, in that order, at the correct concentration and temperature. This will reduce the potential for cross-contamination and prevent detergent from drying on equipment surfaces. Cleaning solution must be applied to every square centimetre of surface, including all food contact surfaces and undersurfaces.

Every cleaning agent has an optimum concentration level at which soil removal is most efficient. A concentration that is too high is as ineffective as a chemical concentration that is too low. Always follow the manufacturer's directions carefully.

It is generally assumed that the hotter the water used in cleaning, the better the cleaning job. This is true only to a point. A water temperature between 43°C and 50°C is best for efficient cleaning. Water that is too hot may cook the soils onto the surface.

Generally, the longer the contact time of the chemical cleaning agent on the surface being cleaned, the better. Check manufacturer's instructions for minimum exposure time.

Some surfaces may require extra scrubbing. Manual cleaning may include using brushes or other hand-operated equipment to remove soil from surfaces. Cloths and sponges can harbour and spread microorganisms from one area to another, so their use should be avoided. Abrasive materials (e.g., steel wool) may scratch surfaces, leading to eventual corrosion. Abrasive materials may also leave behind tiny metal particles that could end up in the food. Clean, sanitized nylon scouring pads may be used instead. Brushes and brooms with food-grade plastic handles and bristles may be used. Squeegees may be used on floors and walls but must be constructed of materials acceptable to the CFIA (e.g., food-grade plastic).

Mechanical cleaning may include water hoses with a spray head, pressure spray devices (high or low pressure using hot or cold water) or steam guns. High-pressure water should be used only after preliminary cleaning has been completed in order to lessen the possibility of contamination by aerosols caused when high-pressure water hits contaminated surfaces.

Using foaming solutions means that cleaning solutions will stick to vertical surfaces. Foam should be applied from the bottom up and rinsed off from the top down.

Closed systems require turbulent flow of water, cleaning agents, water, sanitizing agents and water (in that order) through pumps, valves, connections, pipes and tanks. This is described as clean-in-place (CIP). The optimum water temperature is usually 60°C.

Some equipment must be taken apart for cleaning and sanitation. Clean-out-of-place (COP) requires a soak or circulation tank, which comprises four compartments. Disassembled equipment and utensils are soaked/rinsed in the first compartment, manually cleaned with a cleaning compound in at least 43°C solution in the second, rinsed in the third in 43°C to 50°C water, and sanitized in the fourth with either chemical sanitizers or 77°C water for 45 seconds. In a circulation tank, the velocity of recirculating water, combined with chemical cleaners, cleans equipment parts and utensils. Where three compartment tanks are used, initial cleaning must be "dry."

5. Even on vertical surfaces, minute amounts of cleaner may remain after cleaning. (Cleaners are formulated to "stick" to surfaces.) Thorough rinsing carries away the remaining soil (a biological contamination risk) and the cleaning agent (a chemical contamination risk). Use the lowest effective pressure and volume to avoid aerosols and oversprays. Rinse walls first (from the top down) followed by the floor and drains, with equipment and food contact surfaces (from the top down and in the direction of product flow to keep track of what has been rinsed) last. This order will avoid the potential risk of overspray or splashing on equipment that is considered clean. As noted above, only potable water must be used.

6. Before reassembling equipment, someone not involved in the actual cleaning should conduct a organoleptic (sight and smell) inspection to check that walls, equipment, utensils, food contact surfaces and undersurfaces, floors, and all nooks and crannies are clean. Use of a flashlight may be helpful. Areas that are not completely clean must be cleaned and rinsed again.

7. Much of the floor probably will be covered with cleaner when equipment is cleaned. However, it may be necessary to scrub areas that have been missed. Allow cleaning agents to stand for an appropriate time, then rinse. Don't forget to remove drain covers and to clean inside drains (see "Important Considerations," below). Be careful not to use excessive water pressure that may create equipment-contaminating aerosols.

8. Apply sanitizing solution at the correct concentration, the correct temperature, and for the appropriate contact time to floors first. Then move to equipment, beginning with support structures and working upward until all surfaces are completely covered. As with cleaners, sanitize in the direction of product flow to keep track of what has been done.

After the use of some sanitizers and certain concentrations of others, rinsing with potable water is necessary. Rinsing normally eliminates all traces of chemical sanitizers, but only when all surfaces are flushed with a sufficient volume of water.

Hot water sanitizing is commonly used where immersion of the contact surfaces is practical (e.g., small parts, utensils). Depending upon the application, immersion may last from 45 seconds to 5 minutes at temperatures from 77°C to 85°C.

A 45-second immersion in 77°C water is equivalent to immersion in:

- A 100 ppm chlorine solution for 45 seconds
- A 200 ppm quaternary ammonium solution for 45 seconds
- A 25 ppm iodine solution for 45 seconds.

9. After rinsing, the surface should be air dried to eliminate chemical odours. Drying should be as swift as possible to discourage microbial growth. In some areas (e.g., belt surfaces, floors), it may be necessary to squeegee off water to speed the drying process. Surfaces should never be dried with a cloth or towel that can contaminate the freshly sanitized surface with microbes. Sophisticated operations may lower the relative humidity in the facility so water evaporates more quickly.

Food processors may wish to conduct microbiological tests (via environmental swabs) to confirm that food contact surfaces are free from harmful microorganisms.

10. "If you don't write it down, it didn't happen." As part of the Sanitation Standard Operating Procedure (SSOP), a record indicating completion of cleaning and sanitation activities should be kept. Deviations from prescribed practices and other irregularities should also be noted, as should the corrective actions taken.

Important Considerations

It is important to understand that sanitation is a sequence of steps with each step building upon the successful completion of the previous step. To prevent potential cross-contamination, each step must be fully complete before the next step occurs. For example, if one sanitation worker is performing a pre-rinse procedure on a machine beside another machine where another worker is doing a final rinse, there is risk that an overspray from the dirty machine may contaminate the clean, sanitary surface of the cleaned machine.

The warmer the temperature, the faster microbes grow and reproduce, and the more frequent the requirement for cleaning and sanitation. As a rule of thumb, for every 6°C (10°F) rise in food ingredient or food product temperature, the rate of microbial growth increases by 50 per cent. For example, at 16°C (60°F), the rate of microbial growth in food debris in a processing plant is 50 per cent greater than if the temperature is 10°C (50°F).

The vast majority of human pathogens grow best at temperatures of 25°C to 40°C. (The human body is 37°C.) It should be noted that E. coli grow at

temperatures as low as 10°C; Salmonella at temperatures as low as 7°C and the spoilage bacteria Pseudomonas as low as 4°C. A microbiological monitoring program can be used to determine the period of time necessary between cleanups.

Pay special attention to areas where trapped food and water create ideal growing conditions for microorganisms. These include cracks in floors, pools of standing water, clogged floor drains, tape used for temporary repairs, exposed insulation, open-design conveyor belts, the underside of conveyor belts, hollow rollers, fixed sleeved assemblies, concave surfaces and crannies, and crevices in poorly designed manufacturing equipment. Each of these areas can provide an environment in which bacteria (including pathogens, if they are present) can survive and grow.

Drains are an especially high-risk area because they provide an ideal environment for the growth of the pathogen Listeria monocytogenes. To discourage Listeria growth, clean drain covers and the inside of drains on a regular schedule. Sanitation personnel who handle drain components should be prohibited from cleaning food contact surfaces or equipment until protective clothing has been replaced, footwear has been cleaned and sanitized, hands have been washed and gloves replaced.

As with personnel, sanitation tools should be limited to specific functions. To ensure that this happens, colour-coded tools should be used. For example, one colour should be dedicated to food contact areas, another to non–food contact areas, and a third for cleaning drains and other similar areas.

Aerosols created by high-pressure/low-volume water cleaning can be a source of cross-contamination by carrying microorganisms from non-food contact surfaces to food contact surfaces. Whenever possible, do not use high-pressure air or water to clean food processing and food storage areas. Where pressure sprays cannot be avoided, take care to create as few aerosols as possible. Pressure sprays should never be used as a final rinse because any resulting cross-contamination will negate previous cleaning and sanitation.

Certain items require special cleaning and sanitation methods. For example, dirty control buttons can transfer microorganisms to hands, which, in turn, contaminate food, ingredients, food contact surfaces or packaging. Because control buttons are covered for worker safety during cleaning, a safe, effective cleaning and sanitation method must be developed for them.

Another example is that only one side of screens may be readily accessible for cleaning and sanitation. This may create a potential area of cross-contamination. In this case, develop procedures to remove screens or to partially dismantle equipment to enable complete cleaning and sanitation. Water and/or chemicals may penetrate sealed surfaces such as bearings if they are cleaned and sanitized improperly. In addition to causing premature wear, penetration may create an entrance for

microbes and provide an inaccessible niche for microbial growth.

Applying sanitizer at too low a level or for an insufficient period of time can lead to higher bacterial levels and/or to development of resistant strains of microbes. When this occurs, the area must be "shocked" back to a safe bacterial level by switching to high concentrations of another sanitizer for several days.

A good pest control program is necessary for a cleaning and sanitation program to be effective. Pests, including birds, mice, rats and insects (e.g., flies, cockroaches), can contaminate a food processing facility with urine and droppings, can damage packaging supplies with their gnawing, and can spread a variety of pathogens as they move around the building, equipment and food contact surfaces. Even areas that have been cleaned and sanitized can be recontaminated.

Automated Versus Manual Cleaning

Automated cleaning systems will improve cleaning by consistently controlling cleaner/sanitizer concentration, solution pH and temperature, cleaning/sanitizer contact time and the mechanical force used during cleaning. Automated systems also reduce labour hours and reduce cleaning hours. However, manual cleaning requires less capital outlay, and no re-engineering or retrofitting of the facility is necessary. The benefits of automated cleaning systems are generally greatest in larger operations with large and/or complex equipment.

When meters are used to automatically mix cleaners and sanitizers, the concentration should be checked every day with a commercially available test kit to ensure that it is correct.

Sanitation Standard Operating Procedure (SSOP)

Every food processing facility should have written Sanitation Standard Operating Procedures (SSOPs) for completing sanitation activities. SSOPs provide specific instructions as to how to complete each sanitation activity. Communication of those instructions to sanitation employees is crucial to the success of a cleaning and sanitation program. A brief description of a sanitation training program follows in the next section.

SSOPs should:

- Identify the building areas, equipment and utensils to be cleaned and sanitized
- Indicate the frequency of cleaning and sanitation for each building area, each piece of equipment, and each utensil
- Prescribe the procedures for cleaning and sanitizing
- Specify the chemicals to be used, their concentrations, and the temperature of the cleaning or sanitizing solution
- Designate the job position responsible for each cleaning and/or sanitizing task
- Set a procedure to verify that the cleaning and sanitizing has been effective
- Indicate the record keeping required.

To ensure that no tasks are missed, a master sanitation schedule outlines the frequency with which each sanitation task is to be performed (e.g., daily, weekly, monthly, end of season).

To verify that sanitation activities have been carried out as described, monitor activities and record results. If monitoring discovers deficiencies between the written SSOP and its implementation, take a predetermined corrective action and record the results. If necessary, alter the procedure or retrain staff to ensure that the deviation does not occur again.

After sanitation activities and before resuming food processing activities, do a pre-operational inspection to ensure that all cleaning and sanitation requirements have been met. The evaluation may be organoleptic (sight and smell) or may include environmental swabbing for microbiological laboratory testing.

Generic SSOP

Let us suppose that a food processing plant has a processing line that includes an Imaginary Vegetable Chopper. The example on the next page outlines the elements that should be included in a typical SSOP for that Imaginary Chopper. It is followed by an example of a cleaning record. Keep in mind that records are an integral part of every SSOP.

P3 SANITATION	
P3.1 Cleaning and Sanitation—Imaginary Vegetable Chopper	
Policy	Cleaning and sanitizing procedures will be frequent enough and thorough enough to prevent microbial levels that may endanger the safety of vegetables being processed. Cleaning and sanitizing activities will not themselves contaminate food or adjacent equipment, products or packaging. All cleaning and sanitizing actions will be documented.
Responsibility	Sanitation Supervisor or his or her designee
Frequency	Sanitation to take place immediately before daily operations begin Chopper to be rinsed with water only at each break (mid-morning, lunch, mid-afternoon) Full cleaning and rinsing to take place after each work shift
Records	Imaginary Vegetable Chopper Daily Cleaning and Sanitation Record

Procedure

- Before daily processing begins, sanitize vegetable chopper with 200 ppm chlorine solution. Mix 45 ml of 5.25% unscented bleach in 12 litres of 30°C water (equal amounts of hot and cold water from the taps) in backpack sprayer used for application; apply spray solution to all food contact surfaces and surrounding areas. No rinse is necessary.
- At mid-morning break, during lunch break, and during the mid-afternoon break, use yellow broom and yellow shovel to remove debris from floor. Use garden hose equipped with spray nozzle to remove gross debris from chopper and adjacent areas. Coil and return hose to hanger. Use yellow shovel to scoop debris into inedible waste container.
- At the end of the shift, use yellow broom and yellow shovel to remove debris from floor. Use garden hose equipped with spray nozzle to remove gross debris from chopper and adjacent areas. Use yellow shovel to scoop debris into inedible waste container. Dismantle chopper. Rinse parts with water hose spray nozzle. Place parts in soak tank. Fill soak tank to 200 litre mark with 75°C water (hot water tap only). Add 1 litre of ABC cleaner to soak tank. Use yellow brush to carefully scrub knives. Start recirculation pump. Rinse chopper again with spray from garden hose. Scoop remaining debris into inedible waste container. Mix 250 ml of XYZ concentrate with 4 litres of 30°C water (equal amounts of hot and cold water from the taps) in the foam applicator. Apply foam to all surfaces of the chopper from the bottom up. Drain soak tank. Rinse chopper parts with water from water hose nozzle. Visually inspect parts for cleanliness. Three to five minutes after foam application to chopper, thoroughly rinse with water spray from hose from the top down. Visibly inspect for cleanliness. Coil and return hose to hanger. Reassemble chopper wearing freshly washed gloves. Ask cleaning crew supervisor to inspect for cleanliness and to take environmental swabs, as required. Mix 45 ml of 5.25% unscented bleach in 12 litres of water in backpack sprayer. Apply spray solution to all chopper surfaces. Do not rinse.
- Complete Imaginary Vegetable Chopper Daily Cleaning and Sanitation Record.

Corrective Action

- If, after rinsing, visual inspection by cleaning crew supervisor finds areas that are not clean, cleaning procedures must be repeated until cleanliness is achieved.
- Record corrective actions on Imaginary Vegetable Chopper Daily Cleaning and Sanitation Record.

Prepared: February 9, 2006 Approved by: _____

Revised: _____ Title: _____

Imaginary Vegetable Chopper Daily Cleaning and Sanitation Record

✓ = Yes ✗ = No shaded boxes = not applicable

Date: Feb 9 / 06

Task	Time					Comments	Corrective Action	Initials
	Before Shift	Mid A.M.	Lunch Break	Mid P.M.	After Shift			
sanitize vegetable chopper (45 ml bleach in 12 litres water)	✓							JB
remove inedible debris rinse chopper with water		✓	✓	✓	✓	container overflowing in mid-afternoon	Bill emptied it into outside bin	JB
dismantle chopper rinse parts place in soak tank					✓			JB
pour 200 l 75oC water into soak tank add 1 litre ABC start pump					✓	thermometer indicated water was only 60°C	recalibrated thermometer	JB
rinse chopper again remove inedible debris					✗	didn't need further rinsing		JB
foam chopper from bottom up with XYZ foam cleaner					✓			JB
drain soak tank rinse parts inspect for cleanliness					✓			JB
rinse foam from chopper after 3 – 5 minutes visually inspect					✓	conveyor belt not very clean	foamed conveyor belt again and rerinsed	JB
reassemble chopper supervisor inspection, environmental swabs					✓	looks clean — no swabs taken today		RF
sanitize chopper (45 ml bleach in 12 litres water)					✓			JB
Task	very little XYZ concentrate left							

Cleaning Crew Training

The individual contribution of everyone involved in cleaning and sanitation is essential to the overall success of a sanitation program.

Job-specific training is the process by which cleaning and sanitation crew members are:

- Made aware of why correct completion of their individual tasks is so important to food safety
- Informed of their individual roles and responsibilities
- Instructed how to carry out those tasks correctly.

Begin training by emphasizing the relationship between proper cleaning and sanitation and the hazards that can cause foodborne illness. This may include an overview of biological, chemical and physical hazards associated with the food being packed/processed as well as the various methods and chemicals used for effective cleaning and sanitation. Employees must be able to easily connect the relevance of what is being presented to the jobs they are being asked to do.

Each piece of equipment and/or sanitation task should have a comprehensive, but simply stated, list of procedures that must be followed for cleaning, sanitation, and inspection of walls, equipment, food contact surfaces, utensils and floors (a Sanitation Standard Operating Procedure or SSOP). Training should review these procedures as they relate to the employees being trained. Throughout the training, employees should understand that their contribution to the cleaning and sanitation program is critical to the safety of the food product.

Training should also include proper mixing, use, handling, and storage of cleaning and sanitation chemicals; use of personal protective equipment (PPE); and where to find and how to read Material Safety Data Sheets (MSDS).

Explain how to complete the required documentation and its importance to food safety.

Each employee must have easy access to all written SSOPs that are applicable to his or her roles and responsibilities.

Training must not be restricted to new employees. Established employees, including managers and supervisors, should also receive ongoing training at least annually or when there are changes to the cleaning and sanitation procedures. It is important that back-up personnel also receive the same training for tasks they might be required to perform on a fill-in basis.

Training Delivery

For training to be credible to employees, it should be delivered by qualified individuals who have practical experience in cleaning and sanitation. Trainers should also be able to relate their knowledge/experience to the specific learning needs of individual trainees.

Adults learn best when the learning approach is participatory, problem-centred and relevant to their immediate circumstance. Skills and information that are immediately applicable to the job are most often remembered. Encourage active participation in training sessions by drawing on the trainee's experience. Listen and respond respectfully to trainee questions and concerns.

Use a variety of teaching strategies to accommodate different learning preferences. For example:

- Visual—illustrations, drawings or designs; video presentations or pictures showing examples of "good" and "bad" practices; colour codes to highlight information; printed materials (e.g., copies of SSOPs, handouts, copies of presentations); wall charts; notes
- Auditory—verbal presentations such as lectures, presentations or oral reports; group discussions; verbal exchanges; real-life scenarios; one-on-one instruction
- Tactile—hands-on demonstrations; hands-on experience to learn a task; trying new things without a lengthy explanation; application exercises

Restrict training sessions to one or two concepts per session. Several shorter sessions are much more effective than one long session where employees cannot possibly absorb all the information presented. Reinforce points. Give positive feedback whenever possible.

At the next session, review topics from the most recent session, and discuss how what was learned has been put into practice and what barriers (if any) have been encountered.

Each presentation should be in a language understood by the employee. Symbols and pictures can help overcome language barriers.

The physical environment in which instruction takes place can also affect learning positively or negatively. Take into consideration the room temperature, the arrangement of the room, the time of day, the brightness of the room, the noise level and potential distractions.

In the workplace, reinforce what has been taught with posters, signs and other visual aids placed in strategic, high-traffic locations. Managers and supervisors should also encourage trainees to put into practice what they have learned, to offer encouragement for what is done correctly and to patiently correct what has been done incorrectly.

Self-Assessment

To help assess where your facility stands with regards to cleaning and sanitation, complete the self-assessment form on the following page.

CLEANING AND SANITATION SELF-ASSESSMENT

	Written Records	Yes/No	Comments
1	Written Sanitation Standard Operating Procedures (SSOPs) identify areas, equipment and utensils to be cleaned the frequency of cleaning and sanitation the procedures, and chemicals to be used those responsible the procedure to verify effectiveness corrective actions to be taken and the records required. All have been implemented.		
2	There is a master cleaning and sanitation schedule identifying each piece of equipment, each utensil and each area to be cleaned and sanitized, and the cleaning and sanitizing schedule for each.		
3	Cleaning and sanitizing activities for each piece of equipment, utensil and area are documented and kept on file.		

	Cleaning and Sanitation Procedures	Yes/No	Comments
4	No cleaning practices are performed during operations that could potentially cause product contamination. For example, food and packaging are protected from contamination during cleanups. Water and air pressure are used in a way that does not create water droplets or aerosols that could potentially contaminate food, packaging or food-contact surfaces.		
5	Cleanliness is evident throughout the facility in both processing and non-processing areas. Food-contact surfaces are clean. There are no buildups or accumulations of food products or soil. Spills are cleaned up promptly. Utensils used during processing are cleaned and sanitized regularly. Floors are free of standing water. Hoses are neatly stored off the floor. Good housekeeping practices are observed.		
6	A designated individual(s) other than the individual(s) who performed the cleaning/sanitizing operations routinely performs a sanitation assessment before operations begin or resume.		

	Cleaning and Sanitation Chemicals and Equipment	Yes/No	Comments
7	Cleaning and sanitizing chemicals are acceptable to the CFIA (found on the CFIA's Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products at www.inspection.gc.ca/english/ppc/reference/u1e.shtml		
8	Equipment used for cleaning and sanitizining is constructed of food-grade materials acceptable to the CFIA (found on the CFIA's Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Non-Food Chemical Products at www.inspection.gc.ca/english/ppc/reference/u1e.shtml		
9	Cleaning/sanitizing containers, brushes, applicators, etc. are labelled or colour coded to prevent inadvertent use in unintended areas where there is potential for cross-contamination. Chemicals are stored in a separate, locked area away from food processing or food storage areas.		

	Cleaning and Sanitation Training	Yes/No	Comments
10	There are documented training programs in place for cleaning and sanitation personnel.		

Glossary

acid — a substance containing a high concentration of hydrogen ions, which creates a pH value less than 7.0

aerosols — suspended droplets of liquid, often containing microorganisms; often caused by splashing water against contaminated surfaces in a food processing environment

alkaline — a substance with a relatively low concentration of hydrogen ions creating a pH value greater than 7.0

bacteria — microscopic, single-celled organisms found in soil, air, water, and the intestinal tract and mucous membranes of animals and humans; bacteria cells multiply by dividing in two (called binary fission)

biofilm — an invisible layer of organic secretions, attached to surfaces that appear to be clean and sanitary, that harbour living bacteria cells; can be difficult to remove during cleaning sanitation procedures

Canadian Food Inspection Agency (CIFA) — the federal agency responsible for the enforcement of the policies and standards under the Agriculture and Agri-Food Administrative Monetary Penalties Act, Canada Agricultural Products Act, Canadian Food Inspection Agency Act, Feeds Act, Fertilizers Act, Fish Inspection Act, Health of Animals Act, Meat Inspection Act, Plant Breeders' Rights Act, Plant Protection Act, Seeds Act, and the Consumer Packaging and Labelling Act and the enforcement of the Food and Drugs Act as they relate to food; CIFA focuses on federally registered establishments that engage in interprovincial and export trade.

chelating agent — an organic compound that keeps metals in water from combining; also known as sequestering agents, chelating agents prevent metal buildup that causes staining

chemical agent — a compound that increases the effectiveness of water in removing soil and other foreign materials from surfaces

cleaning — the process of removing surface dirt, debris and associated bacteria from a surface by washing with water and detergent

clean-in-place (CIP) — a continuous system whereby cleaning or sanitizing agents are recirculated through intact machinery

clean-out-of-place (COP) — a cleaning and sanitizing system used for equipment that can be disassembled and placed in a soak or circulating tank

cross-contamination — the transfer of harmful microorganisms from one person, object, food or place to another through a non-food surface such as equipment, utensils or human hands

enteric pathogens — illness- or disease-causing microorganisms found in the intestinal tract of humans

food-spoilage microorganisms — fungi and bacteria commonly found on fresh produce that impair its flavour, aroma and appearance; they include

Pseudomonas spp., lactic acid bacteria such as Leuconostoc mesenteroides and Lactobacillus spp., Erwinia herbicola, Flavobacterium, Xanthomonas, Enterobacter agglomerans, yeasts and moulds. The type and magnitude of microbial growth can vary greatly for different produce items and storage conditions.

fungi — parasitic organisms that lack chlorophyll, they grow on living or dead organisms; yeast and moulds are types of fungi along with rusts, mildews, smuts and mushrooms

inorganic — derived from mineral sources; examples include sand, salt, iron, calcium salts

Material Safety Data Sheets (MSDS) — fact sheets designed to reflect the hazards of working with and/or storing a particular chemical; they provide workers with information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment and spill/leak procedures.

microbe — another word for a microorganism

microorganisms — living entities that are too small to be visible to the naked eye; they include bacteria, viruses, protozoa, and fungi such as yeasts and moulds

microbiological — an adjective used to express an attribute relating to microorganisms, e.g., the microbiological quality of water

moulds — multicellular organisms that form fuzzy or powdery patches (mycelium) on organic matter such as fruits and vegetables; along with yeast, they are fungi

organic — carbon-containing compounds obtained from plant or animal sources

parasite — an organism that obtains nourishment from a living plant or an animal in order to grow and reproduce, usually to the detriment of the host

pathogen — a microorganism that is capable of causing illness or disease when it enters the human body

pathogenic microorganisms — illness- or disease-causing bacteria, protozoa, viruses or fungi

personal protective equipment (PPE) — equipment or clothing worn to prevent injury or illness from occurring while handling hazardous materials

pH — the acidity or alkalinity of a liquid measured by the concentration of free hydrogen ions and expressed on a logarithmic scale. If the pH is below 7.0, the solution is acidic (the lower the number, the greater the degree of acidity); if it is above 7.0, the solution is alkaline (the higher the number, the greater the level of alkalinity). A pH of 7.0 is neutral (neither acid nor alkaline).

physical agent — includes heat, cold, noise, radiation, electricity, etc. that can occur naturally or can be produced, e.g., heat is a physical agent that be the result of the weather or be created to kill microorganisms

Sanitation Standard Operating Procedure (SSOP) — written step-by-step procedures that describe in detail how cleaning and sanitation procedures should be done to comply with Good Manufacturing Practices requirements related to cleaning and sanitation

sanitizing — use of heat or chemicals to reduce the number of microorganisms on a clean surface to safe levels

Standard Operating Procedures (SOPs) — written step-by-step procedures that describe in detail how a procedure should be done to comply with Good Manufacturing Practices requirements, except those related to cleaning and sanitation

surfactant — an agent that reduces the surface tension of a liquid (usually water) to permit the penetration of cleaning compounds by increasing the emulsifying, foaming, dispersing, spreading and wetting properties of a product; reduces the surface tension between two liquids

turbidity — cloudiness in water caused by suspension of clay, silt, other finely divided organic and inorganic matter, and microscopic organisms

virus — an ultramicroscopic piece of nucleic acid (DNA or RNA) wrapped in a thin coat of protein that can be seen only with an electron microscope; very infectious and often pathogenic, a virus reproduces by inserting itself into a living host cell and altering the function of that cell

yeast — a unicellular fungus that grows spherical or oval single cells rather than mycelium; can be either beneficial or detrimental in food processing

Notes

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